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Preview of the Results of Aerial Spraying in New Brunswick in 1982: Operational Status Report

E. G. Kettela, Maritime Forest Research Center

In 1982 some 1,724,570 hectares of forest land were sprayed in New Brunswick in an attempt to save as much foliage as possible from the spruce budworm. (Figure 1). Included in this area of spraying were 12,000 hectares of experimental spraying; 8,000 hectares with Matacil Flowable and 4,000 hectares with various commercial formulations of Bacillus thuringiensis.

Large scale operations were conducted by Forest Protection Ltd. (1,693,000 ha) and by Forest Patrol Ltd. (31,570 ha). The 31,570 ha sprayed by Forest Patrol Ltd. were over and above the 48,380 ha that they sprayed for Forest Protection Ltd.

Operational Spraying: Spray operations by Forest Protection Ltd. commenced on 27 May and finished on 19 June, 1982. Ninety-four areas in the operational spray program were sampled to determine efficacy of spraying. Assessment is based on a comparison of budworm survival and defoliation in treated and non-treated plots. Detailed analysis of the data is underway. However, for the purpose of this preview a quick scan of the data indicates:

1. that in the woodlot operation, areas treated twice had substantially more foliage saved than in areas treated once but that the results in all areas treated appear quite variable; (tables 1 & 2)

2. that in areas treated at a dosage of 210 g fenitrothion in 0.73 l formulation/ha the results seem more variable than in areas treated at 210 g fenitrothion in 1.46 l formulation/ha application; and

3. that in the large blocks, areas treated twice had a higher level of foliage protection than in areas treated once.

On the average the results appear to be similar to those obtained in 1981.

This statement has been provided for use in the Forest Pest Control Forum. As detailed analysis of the spray data is incomplete, observations made here are of a preliminary nature only.

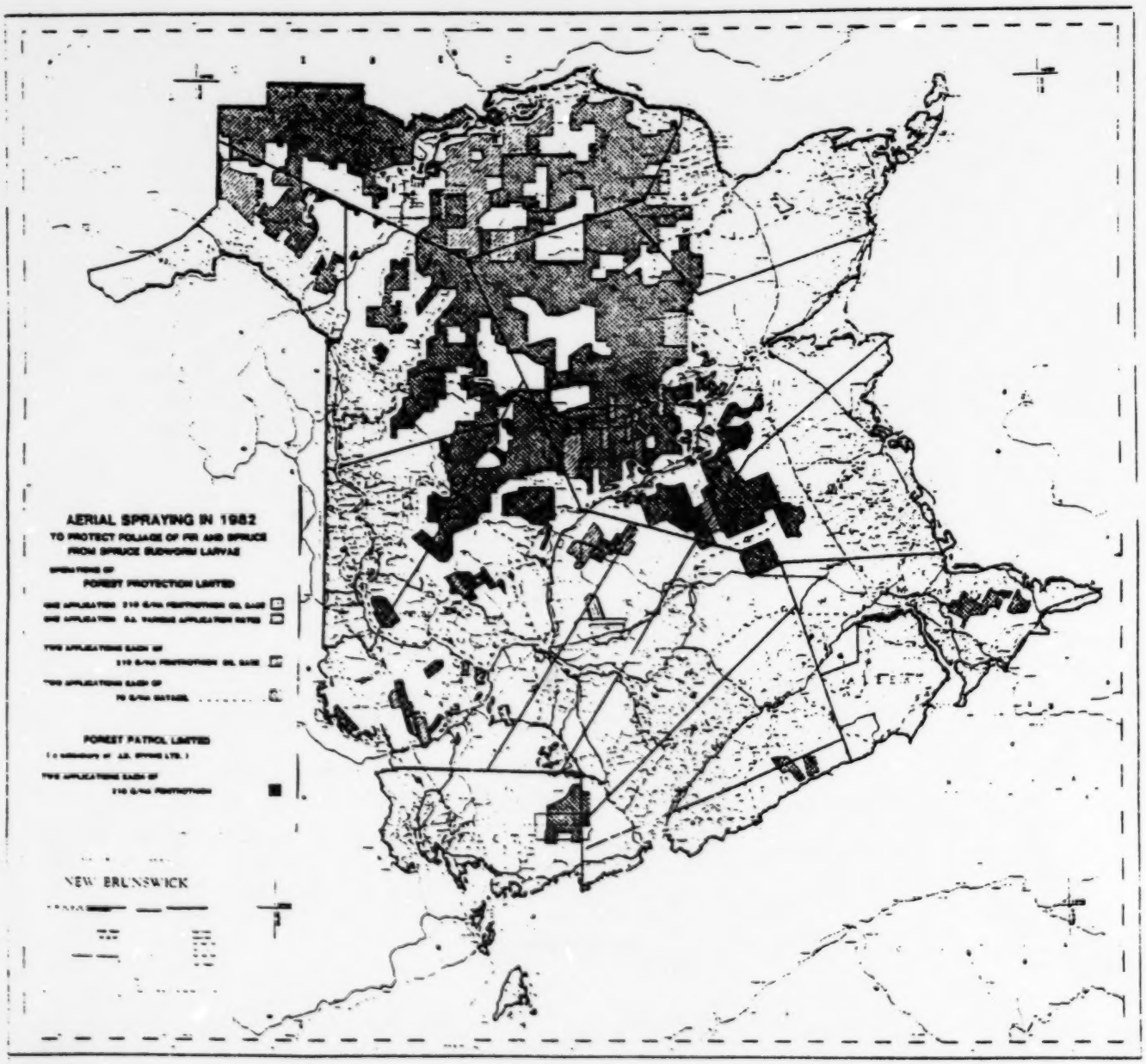

Figure 1. Aerial spraying operations against spruce budworm larvae in New Brunswick , 1982.

Table 1: Summary of the results of spraying in selected woodlots treated with fenitrothion & Dowanol, 1982

Woodlot	BALSAM FIR: Budworm / 45/cm.br. Pre-Spray Larval	Pupae Post-spray	Survival (%) Obs	Exp(a)	$\bar{x}$ % Reduction in Survival(c)	Defoliation Obs.	Exp.	% foliage Saved (d)	Date Sprayed	Estimated Larval Development Index
	S P R A Y E D O N C E (210 g/ha)									
A 275	10.1	1.5	15	32	53	65	66	1	June 5&6	4.04
B 22	13.2	4.1	31	35	12	75	71	0	" 7&8	3.86
B 24	12.1	1.7	14	34	59	56	68	12	" 7	3.86
B 25	14	1.5	11	35	67	69	70	1	" 5	3.86
B 27	7.1	1.4	20	28	29	44	60	16	" 6&7	3.86
B 29	21.5	2.6	12	32	63	90	87	0	" 6	3.86
	S P R A Y E D T W I C E (210 g/ha/application)									
A 50	8.1	0.5	6	30	80	70	63	0	June 9 " 14	4.98 5.57
A 51	7.1	0.4	6	28	79	44	61	17	" 9 " 14	4.98 5.57
A 52	8.4	0.4	5	31	84	26	63	37	" 9 " 14	4.98 5.57
B 14	8.8	0.3	3	32	91	29	64	35	" 9 " 14	4.98 5.57

a) determined from survival/ L_3 graph developed from unsprayed woodlot controls (Fig.1) *

b) " " defoliation / L_3 graph for unsprayed woodlot controls (Fig.2) *

c) % reduction in survival due to spraying = $\frac{\text{(Expt. surv. = obs. surv.)}}{\text{Exp. Surv.}} \times 100$ - (Modified Abbott's Formula)

d) % foliage saved = (Expected - Observed).

* Figures 1 and 2 not available at time of publishing

Table 2 : Summary of the results of spraying in selected woodlots treated with Fenitrothion & Dowanol, 1982

RED/BLACK SPRUCE

Woodlot	Budworm 45 cm/br Pre-Spray	Pupae	Survival % Obs.	Exp. (a)	x̄ % Reduction in Survival (c)	Defoliation Obs.	Exp. (b)	Date Sprayed	Estimated Larval Development Index
	S P R A Y E D O N C E (210g/ha)								
A 275	17.5	1.5	9	23	61	M-S	M-S	June 5&6	4.0
B 22	15.7	3.1	20	23	13	L-M	M	" 7&8	4.3
B 24	6.1	1.5	25	26	4	L-M	M	" 7	4.3
B 25	14.5	1.8	12	24	50	L-M	M	" 5	4.3
B 27	16.4	1.2	7	23	70	M	M	" 6&7	4.3
B 29	27.6	1.2	4	18	78	M	M	" 6	4.3
	S P R A Y E D T W I C E (210g/ha/application)								
A 50	--	-	--	--	-	-	-	June 9	3.8
								" 14	5.1
A 51	-	--	-	-	-	-	-	" 9	3.8
								" 14	5.1
A 52	7.7	1.6	21	28	25	M	M	" 9	3.8
								" 14	5.1
B 14	-	--	-	-	-	-	-	" 9	3.8
								" 14	5.1

a) determined from survival /L_3 graph developed from unsprayed woodlot controls (Fig.1)*

b) " " defoliation /L_3 graph developed from unsprayed woodlot controls (Fig.2)*

c) % reduction in survival due to spraying = $\frac{\text{(Expt. surv. obs. surv.)}}{\text{Expt. Surv.}}$ X 100 - (Modified Abbott's Formula)

d) % foliage saved = (Expected - Observed).

* Figures 1 and 2 not available at time of publishing

1982 Results of Aerial Surveys for Current Spruce Budworm Defoliation in New Brunswick and a Review of the Methodology

E. G. Kettela, Maritime Forest Research Center

In 1982 an estimated 1 387 000 ha of defoliation were mapped in N. B. of which 811 000 ha were categorized as severe, 391 000 ha as moderate, and 185 000 ha as light. This represents a slight increase in the level of defoliation (2%) over 1981 when a total of 1 356 000 ha of defoliation was mapped. Most of this increase was the result of an increase in the area of severe defoliation (Table 1). The level of defoliation does not approach that recorded in 1975 which was typical of the level of defoliation in the period from 1972 to 1975.

Defoliation occurred in variable sized patches throughout the province except in the areas south of Grand Lake and east of the St. John River to Moncton where only a few isolated cases of defoliation were detected.

Extensive areas of moderate or severe defoliation were detected as follows: along the Fundy Coast from Fundy National Park west to the area around St. Martins; south and west of Fredericton to the Maine border; generally north and west of Fredericton to Juniper and Perth-Andover; from Perth-Andover north along the Tobique River with large contiguous areas around Sisson Reservoir and in the Trousers Lake areas; in large patches throughout the forest north of Grand Lake along and adjacent to the St. John River Valley to Edmundston and through the "Panhandle" area of Madawaska County; in the northwest corner of N. B. adjacent to Quebec, along the Patapedia River Valley; throughout much of the forest south of Campbellton, in the Popple Depot area and east along the Nepisiguit River; in the forest north and south of Newcastle and Chatham and throughout the main southwest Miramichi River Villey, and Nashwaak River Valley from Newcastle to Fredericton.

Although the boundary of the spray program is not shown on the map, an estimate of the amount of defoliation that occurred inside the general outline of the sprayed area as compared to the amount outside the sprayed area was determined from the working maps of defoliation and area sprayed from 1981 and 1982 (Table 2). In this analysis, the sprayed area was taken to be all that area delineated on the maps which included omissions from spraying such as shut-offs for streams, lakes, roads, unsusceptible forest, etc.

In 1982, 364 000 ha of light, moderate and severe defoliation were detected in the sprayed area compared to 320 000 ha in 1981. Further, in 1982, 21.5% of the sprayed area was defoliated compared to 1981 when 16.8% of the spray area was defoliated.

Looking at it from a different point of view, of the total defoliation, 81% of the severe defoliation, 70% of the moderate defoliation and 51% of the light defoliation occurred outside the spray area.

Operations and Data Processing:

The 1982 aerial survey in N. B. was conducted under the general supervision of the Canadian Forestry Service with major manpower and financial support provided by Forest Protection Limited and the N. B. Department of Natural Resources. Experienced personnel with an aggregate total of 59 field seasons on aerial surveys came from F.P.L. (3 people - 11 seasons), D.N.R. (4 people - 17 seasons) and C.F.S. (2 people and 31 seasons of experience). A total of 146 hours of aircraft time and in excess of 12 500 km of flight line were flown. Base Gagetown, south of Fredericton, was not surveyed in 1982.

Initially, 10 categories of defoliation were mapped in provincial map books (scale 1 inch: 3 miles) then transferred to a 1:250 000 scale map. Four copies of defoliation maps were prepared and are available for inspection at the Maritimes Forest Research Centre.

In the preparation of a more easily read map (Figure 1) defoliation categories were pooled as follows:

Defoliation Categories Mapped	Categories pooled (on map as)	For simplicity in Tables
patches of light light	light and patches of light	light
light with moderate or severe patches patches of moderate moderate	light to moderate	moderate
moderate with patches of severe patches of severe severe	moderate to severe	severe

The area of defoliation in each category was determined from the

1:250 000 scale defoliation map with the aid of dot grid (36 dots/in^2, 1 dot = 249 acres or 105 ha).

Limitations and Use of Aerial Surveys:

Aerial surveys, using ocular estimation and sketch mapping methodology, have been conducted annually since 1950 in New Brunswick (Webb & Williams, 1956 and Knox & Webb, 1980) to provide a cartographic representation of the nature and extent of current spruce budworm defoliation. Within the limitations of such aerial surveys an attempt has been made to provide as complete a picture as possible on aerially visible current spruce budworm defoliation. Initially these surveys varied in intensity depending on resources and the extent of the infestation, but for the past 12 years they have been conducted in a more systematic fashion on a province-wide basis. East-west flight lines about 5 kilometres apart are flown at an altitude of 300 meters and the intensity and limits of defoliation (the characteristic red-brown coloration of spruce and fir foliage resulting from feeding by spruce budworm larvae) are categorized and sketch-mapped to a distance of at least 2.5 kilometres on either side of the flight lines.

The reliability and utility of sketch mapping techniques in forest pest damage appraisal has been reviewed by Harris and Dawson (1979). In the New Brunswick context, survey accuracy is dependent on at least 11 factors.

These are:

1. timing of surveys (including time of day)
2. duration of survey
3. weather conditions (lighting, clouds, haze, turbulence)
4. experience and skills of observers
5. training of observers
6. experience of pilots
7. fatigue (resulting from heat and hours of flight time)
8. conditions and type of forest
9. topography
10. infestation make-up (continuous or patchy)
11. efficient coordination and logistics

Weather, experience of observers and fatigue are critical factors. However, the most critical factor is perhaps the extent and configuration of defoliation.

It is relatively easy to map defoliation when it is severe and occurs over extensive areas, but it is much more difficult to map defoliation in heterogeneous, discontinuous forests that have a history of past damage and in which defoliation occurs in patches. Cloud, and

particularly haze, makes the distant edges of the defoliation difficult to define which accounts for the stripping pattern on some defoliation maps. Some years it is impossible to carry out an aerial survey (1973 for example) and in such occasions attempts are made to determine the extent of defoliation from ground surveys. In any event, limited ground surveys for defoliation are made on a regular basis to verify defoliation intensity estimations from the air.

The results of defoliation surveys provide a statement on the nature and extent of spruce budworm caused damage on a year-to-year basis. These surveys can influence forest management decisions such as cutting plans and the planning of protection operations. In addition, information from defoliation surveys, particularly in New Brunswick, is one of two sets of data used to assess the efficacy of foliage protection programs. The aerial defoliation surveys give an estimate of the spatial extent of damage in large treatment areas while ground sampling of defoliation and spruce budworm populations before and after spraying provide detailed quantitative data from individual sample trees and plots.

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Knox, Sharon, and F.E. Webb. (1981). Aerial Evaluation of Damage from Spruce Budworm Attack in New Brunswick, New Methodology - 1980. Forest Protection Limited Technical Report 80 / T / 3.

Webb, F.E. and L.E. Williams. (1956). Studies of Aerial Spraying against the Spruce Budworm in New Brunswick. IV. Techniques for aerial surveys of defoliation and damage 1954-55. Interim Report 1955-4. Forest Biology Laboratory, Fredericton, N.B.

Table 1: Estimated area of Spruce Budworm caused defoliation in New Brunswick from 1975 to 1982 as determined from maps showing the results of aerial defoliation surveys.

Year	Defoliation Category* ('000 ha) Light	Moderate	Severe	Total
1975	820	861	2,706	4,387
1976	192	174	230	596
1977	123	134	347	604
1978	141	219	450	810
1979	105	235	1,085	1,425
1980	176	226	447	849
1981	135	382	839	1,356
1982	185	391	811	1,387

*Light, moderate, severe - see text for explanation of pooling categories

Table 2: Comparison of defoliation in sprayed and non sprayed areas, 1981 - 1982 (ha x 1000)

	Defoliation			Total Defoliation
	Light	Moderate	Severe	
		1981 (Area sprayed 1,900)		
Provincial Total	135	382	839	1,356
Area of Defoliation in sprayed area	52	104	164	320
As a % of Provincial Total	39	27	20	24
Defoliation in treated areas as % of sprayed area	2.7	5.5	8.6	16.8
		1982 (Area sprayed 1,693)		
Provincial Total	185	391	811	1,387
Area of Defoliation in sprayed area	90	116	158	364
As a % of Provincial Total	49	30	19	33
Defoliation in treated areas as % of sprayed area	5.3	6.9	9.3	21.5

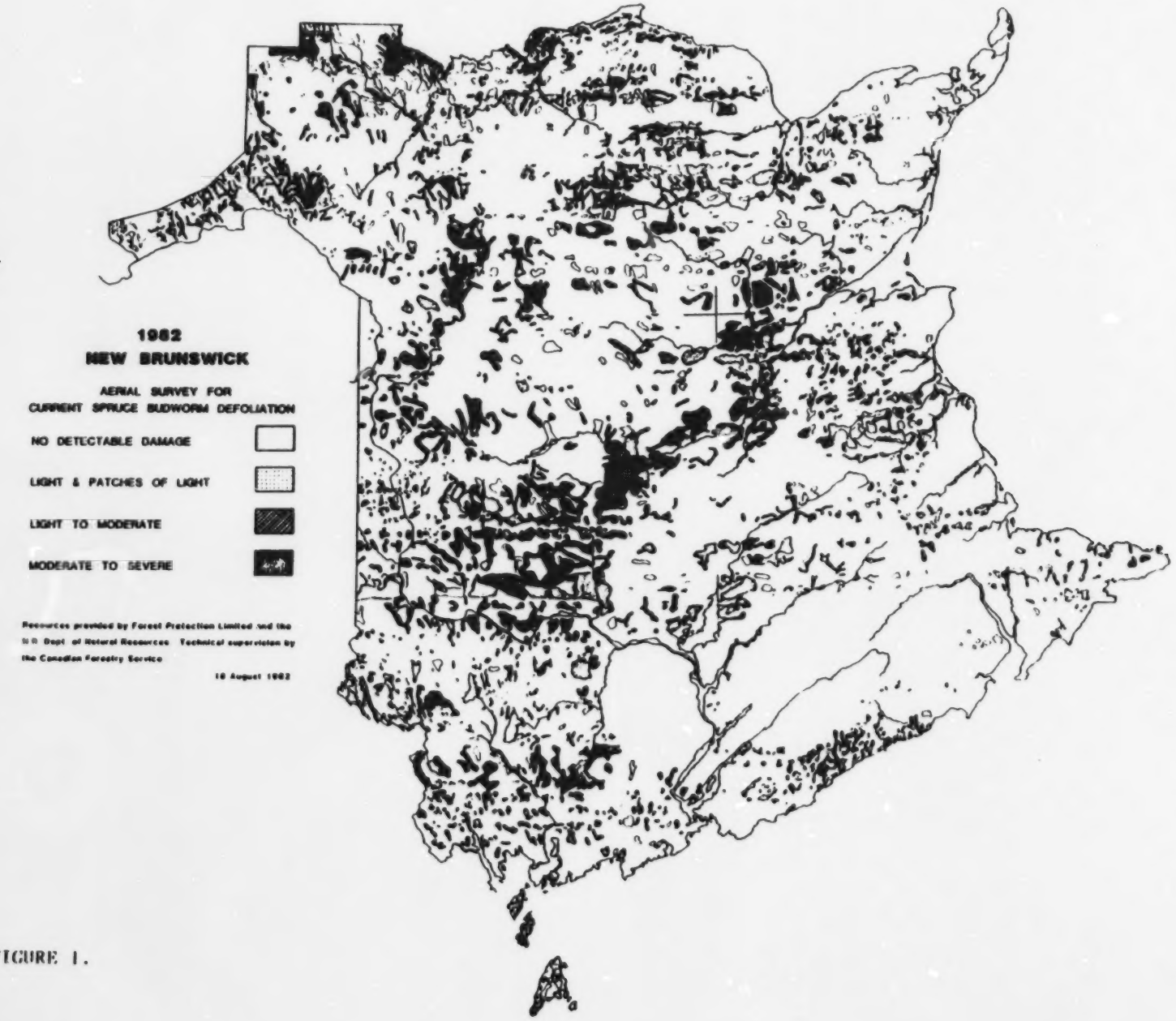

1982
NEW BRUNSWICK
AERIAL SURVEY FOR
CURRENT SPRUCE BUDWORM DEFOLIATION
NO DETECTABLE DAMAGE
LIGHT & PATCHES OF LIGHT
LIGHT TO MODERATE
MODERATE TO SEVERE
Resources provided by Forest Protection Limited and the
N B Dept of Natural Resources Technical supervision by
the Canadian Forestry Service
10 August 1982

FIGURE 1.

Summary of 1982 Insecticide Spraying of New Brunswick Forests and Woodlands

	hectares	acres
Fenitrothion (210 g a.i./ha/application)	1,736,720	4,341,800
Aminocarb (70 g a.i./ha/application)	8,600	21,500
Bt (various application rates)	4,000	10,000
Total	1,749,320 *	4,373,380

* includes spraying to control spruce budworm (1,742,530 ha) and spruce budmoth (11,000 ha)

Forest Protection Ltd.	hectares	acres
spruce budworm		
Fenitrothion	1,681,000	4,202,500
Aminocarb	8,000	20,000
Bt	4,000	10,000
	1,693,000	4,232,500

Forest Patrol Ltd. (a subsidiary of J. D. Irving Ltd.)

spruce budworm		
Fenitrothion	31,570	78,925
spruce budmoth		
Fenitrothion	11,000	27,500
	42,570	106,425

Forest Pest Management Institute

spruce budworm		
Fenitrothion	550	1,370
Aminocarb	600	1,500
	1,150	2,870

Summary of forest insecticide studies conducted by the Canadian Wildlife Service in New Brunswick in 1982. - D. G. Busby and P. A. Pearce.

The influence of application methodology on brain cholinesterase inhibition in songbirds exposed to aerial Matacil^{R} 1.8F spraying

It is recognized that the specific technique of applying a pesticide may influence the effects produced on target and non-target fauna, even though the active ingredient dosage may remain constant. During the field seasons of 1981 and 1982 we had the opportunity of observing the impact on songbirds of three different applications of Matacil^{R} 1.8F, a new flowable preparation of aminocarb. The results of the first application were reported to this forum in 1981. For that study, Matacil^{R} 1.8F was formulated as follows: 25.93% Matacil^{R} 1.8F, 1.27% Atlox^{R}, 72.2% water and 0.53% Rhodamine Red dye. The emulsion was applied at a rate of 1.46 L/ha and active ingredient dosage of 70 g/ha. The spraying was by Cessna 188 Ag-Truck fitted with four Micronair AU3000 rotary atomizers. Bird exposure to spraying was assessed by determination of brain cholinesterase (ChE) activity in five species of warblers. None of the species-samples showed depression of ChE after spraying. Only four individual birds exhibited ChE inhibition of more than 20%, the level of inhibition strongly indicative of exposure to the toxin.

In the 1982 field season we examined brain ChE activity in five species of songbirds exposed to two different formulations of Matacil^{R} 1.8F. The species sampled were: Tennessee Warbler (Vermivora peregrina), Magnolia Warbler (Dendroica magnolia), Bay-breasted Warbler (D. castanea), American Redstart (Setophaga ruticilla) and White-throated Sparrow (Zonotrichia albicollis). The two formulations were: (1) oil formulation consisting of 25.93% Matacil^{R} 1.8F and 74.4% I.D. 585 oil; (2) emulsion formulation consisting of 25.93% Matacil^{R} 1.8F, 1.27% Atlox^{R} and 72.8% water. Both formulations were applied twice according to routine operational spraying protocol. Application was by TBM aircraft using boom and nozzle hardware equipped with 110-10 Tee-jet nozzles. Each formulation was emitted at a rate of 1.46 L/ha and an active ingredient dosage of 70 g/ha, as in 1981.

The results of brain ChE analyses of birds from the two spray blocks are quite different. Species-samples from the oil block had brain ChE activities very similar to the control birds - there was no statistically significant decrease after spraying. Data from only a few birds suggested exposure to the spray (i.e. brain ChE was inhibited more than 20%). A sample of Tennessee Warbler collected on day two after the first spray showed a significant increase in brain ChE activity. All species sampled from the emulsion block exhibited a decrease in brain ChE activity. Bay-breasted and Tennessee Warblers were most affected; however, Magnolia Warblers and American Redstarts also showed consistently lower brain ChE activity than did control birds. Interestingly, no more birds from the emulsion block exceeded the 20% ChE inhibition level tnan in the oil block.

The results of this study suggest that the application method can influence the impact of the spray on songbirds. An interesting contrast is found when the two identical formulations (except for presence of the dye) are compared. The TBM aircraft using boom and nozzle hardware produced considerably more impact than did the Cessna aircraft using rotary atomizer hardware. Results from the oil-sprayed block are inconclusive. Little ChE inhibition was observed: however, the spraying of that block was irregular, some parts being completely missed during the spraying operations. It is possible that some of our birds were collected from those unsprayed sections.

Even though there appears to be measurable differences between different application techniques of Matacil^{R} 1.8F, the level of impact in all cases was minor. In all sprays only a small number of birds exhibited brain ChE inhibition of more than 20% and no birds exceeded 50% depression, the level at which direct mortality may occur. All of our evidence suggests that Matacil^{R} 1.8F sprayed at 70 g A.I./ha has less of an impact on birds than does fenitrothion sprayed at 210 g A.I./ha.

Oral toxicity of Matacil^{R} 1.8F to nestling White-throated Sparrows

To complement an investigation of the effect of a simulated operational aerial spray of aminocarb on brain cholinesterase activity in selected forest passerines, a study was undertaken on the oral toxicity of that insecticide to nestling White-throated Sparrows (Zonotrichia albicollis), and to smaller numbers of the young of other ground-nesting songbirds. The work was carried out in forest cutovers, prime nesting habitat, at the Acadia Forest Experiment Station during the spring and summer of 1982. The study paralleled an earlier one on fenitrothion, reported to this forum in 1980. Active ingredient was in technical Matacil^{R} 1.8F, a new flowable preparation of aminocarb, as supplied by the manufacturer. Nestlings were dosed in situ using a microsyringe technique to introduce known amounts of the insecticide into capsules of the hair-cap moss (Polytrichum commune) which were then fed to the birds. (At high dosages it was necessary to administer the chemical directly to the nestlings through intubation.) Untreated individuals in each nest served as controls.

In initial range-finding trials it was found that an insecticide dosage of 150 ug A.I./g was lethal to all treated nestlings. Thereafter, single insecticide dosages of 0, 50, 75, or 100 ug/g were each administered to at least ten individuals determined to be four days old. A much smaller number of birds were dosed at ages other than four days. To quantify any potential effect on growth and development, treated birds and controls were weighed daily at which time the length of tarsus, wing, and outer primary were measured. Results, briefly, were as follows: six of 13 nestlings died at a dosage of 100 ug/g, one nestling of 11 succumbed at a dosage of 75 ug/g, and a dosage of 50 ug/g was lethal to none of the ten birds treated. One control bird died from unknown causes. There was

no measurable inhibitory effect of the treatments on the growth of the birds: weight increased as rapidly as in control birds, as did the other growth parameters measured. While the birds were being handled, overt behavioral signs of poisoning were rarely noted. A few nestlings of Hermit Thrush (Catharus guttatus), Nashville Warbler (Vermivora ruficapilla), and Common Yellowthroat (Geothlypis trichas) were subjected to the same testing protocol, which induced essentially similar responses, i.e. lethality at highest dosages but universal lack of observed impact on growth and development.

Compared with fenitrothion, which we earlier found to induce measurable growth perturbations in a test population of nestling White-throated Sparrows at a dosage of 7 ug/g, and to cause some mortality of 50 ug/g, aminocarb was considerably less toxic. Although both insecticides are cholinesterase inhibitors, recovery from exposure to aminocarb, a typical carbamate, may be relatively much more rapid and dosed nestlings less likely to fail to respond to feeding visits to the nest by parent birds. The few published data on the oral toxicity of aminocarb to passerines suggest that the birds we treated should have been less tolerant of the lower dosage regimes we employed. Our experience in the present and other studies also suggests that the response of songbirds to administered insecticide may be relevant to species, age, and also the manner of formulation of the insecticide active ingredient in the technical material used.

Although this study not surprisingly raised several questions it supported the position that at dosage rates conventionally applied for spruce budworm suppression in New Brunswick, the use of aminocarb should, to reduce hazard to songbirds, be preferred to that of fenitrothion - a recommendation contained in the 1980-81 report of the province's Committee for Environmental Monitoring of Forest Insect Control Operations.

SUMMARY REPORT ON STUDIES OF THE IMPACT OF INSECTICIDES ON FOREST ECOSYSTEMS (Study Reference FP-15), Report to the 1982 Forest Pest Control Forum

P. D. Kingsbury, B. B. McLeod, S. B. Holmes, D. P. Kreutzweiser, R. L. Milliken and K. L. Mortensen, Forest Pest Management Institute

INTRODUCTION

Field studies carried out by the Environmental Impact Section of the Forest Pest Management Institute in 1982 evaluated the effects of semi-operational application of MATACIL^{R} 180F Flowable formulations and small block and ground applications of aminocarb and fenitrothion water based formulations with the emulsifier TRITON^{R} X-100 on forest songbirds, aquatic organisms and some non-target insects. MATACIL^{R} 180F studies carried out in 1982 were intended to complement studies reported in 1981 to provide required data for evaluating this new aminocarb formulation for registration as a spruce budworm, Choristoneura fumiferana Clem., control agent. Studies on formulations containing TRITON^{R} X-100 were initiated as part of the CFS "Action Plan" to provide new registered tank mixes of aminocarb and fenitrothion set up in the late spring of 1982 in response to the decision not to allow the use of the emulsifier Atlox 3409F in forest spray programs in New Brunswick.

Field studies evaluating pesticide treatments are summarized in Table 1.

AMINOCARB FLOWABLE STUDIES

New Brunswick

Forest songbird, benthic invertebrate and native fish (Atlantic salmon and brook trout) populations were intensively monitored in 3000-5000 ha forest blocks treated by TBM aircraft with oil and water based aminocarb flowable (MATACIL^{R} 180F) formulations. Territorial mapping and netting studies did not indicate any changes in the overall breeding patterns of songbirds on either treated block, and numbers and weights of fledgling birds captured after completion of the spray program were similar on treated and untreated check blocks. No increased drift of benthic invertebrates or subsequent depletions of benthos were found in streams in the aminocarb blocks. A modest increase was noted in terrestrial invertebrates entering the water based formulation treated stream after each application, and juvenile salmon showed some opportunistic feeding on this spray related knockdown. Changes in fish population density in treated and control streams were fairly similar, although juvenile salmon density in the water based treated stream decreased to a greater extent (48%) in late June than in the control stream (27%), probably in response to fluctuating water levels.

Overall, both aminocarb formulations had very little observable impact on the organisms studied. Details of this work are reported in:

Table 1. Field formulations evaluated by FPMI's Environmental Impact Section in 1982.

Field formulation tested	Application Equipment	Ecological components studied		
		Aquatics	Birds	Insects
MATACIL® 180F + ID 585 (2 x 70 g AI/ha)	TBM aircraft	X	X	
MATACIL® 180F + ATlox 3409F + water (2 x 70 g AI/ha)	TBM aircraft	X	X	
MATACIL® 180F + canola oil (2 x 52 g AI/ha)	DC-4G aircraft		X	X
MATACIL® 180F + TRITON® X-100 + water (2 x 70 g AI/ha)	AgCat + AgTruck aircraft	X	X*	X*
	Hand sprayer (MICRON ULVA)	X		
fenitrothion + TRITON® X-100 + water (2 x 210 g AI/ha)	AgTruck + AgTruck aircraft	X		
	Hand sprayer (MICRON ULVA)	X		
fenitrothion + TRITON X-100 + Cyclosol 63 + water (2 x 210 g AI/ha)	AgTruck aircraft	X	X*	X*
	Hand sprayer (MICRON ULVA)	X		

* only single application studied

Millikin, R. L. 1982. Songbird studies in New Brunswick forests treated with semi-operational applications of MATACIL[R] Flowable formulations in 1982. Forest Pest Management Institute File Report 39.

Kreutzweiser, D. P. 1982. Aquatic impact studies in New Brunswick forests treated with semi-operational applications of MATACIL[R] Flowable formulations in 1982. Forest Pest Management Institute File Report 40.

Quebec

Forest songbird and bumblebee populations were surveyed in a 5000 ha spray block in the lower St. Lawrence River area treated twice with aminocarb flowable delivered by DC-4G aircraft in a vegetable oil (canola oil) carrier. Songbird activity patterns and territorial mapping techniques did not indicate any damage to populations or their reproductive activities, but a single male Tennessee warbler was observed demonstrating symptoms of aminocarb poisoning in an area between two spray lines treated less than 10 hours apart due to completion the next morning of an interrupted spray application started the previous evening. Bumblebee populations and activity appear to have been affected by weather rather than the insecticide treatments as declining activity in the treatment block was paralleled in the untreated check area.

Details of these studies are reported in:

McLeod, B. B. and P. D. Kingsbury. 1982. Terrestrial impact studies of MATACIL[R] Flowable formulated in vegetable oil, Quebec, 1982. Forest Pest Management Institute Report No. 41.

ACTION PLAN STUDIES

New Brunswick

Forest songbird and terrestrial invertebrate populations were monitored in two approximately 500 ha spray blocks treated by single engine aircraft with aminocarb and fenitrothion aqueous formulations containing the emulsifer TRITON[R] X-100. Forest songbirds monitored through a single application did not suffer any measurable impact. Immediate knockdown of primarily larval insects from balsam fir and spruce was observed with both insecticides, and lasted for at least five days after treatment. Knockdown of winged insects on the untreated check plot some 70 km distant from the

spray blocks was probably caused by insecticide drift from operational sprays in the general area.

Aquatic invertebrates were studied through double applications of one aminocarb formulation and two fenitrothion formulations containing TRITON^R X-100 applied to streams by single engine aircraft, and also through applications by hand sprayer of the same formulations to produce residue levels in streams in excess of those present after the aerial applications. The two aerial and ground applications of aminocarb resulted in peak concentrations of 2.3, 0.5 and 6.2 ppb in stream water, respectively. Aerial applications caused modest increases in invertebrate drift, while the ground application caused an immediate increase in total invertebrate drift to about 14 times the level at the upstream control site, primarily due to increased drift of blackfly larvae. Aerial applications of fenitrothion introduced peak concentrations of 1.8 ppb or less into streams with little resulting increased drift of invertebrates. Ground applications of fenitrothion formulated with TRITON^R X-100 resulted in peak residues of 4 and 21 ppb in stream water, and increased total drift by factors of up to 4 and 22 times upstream drift, respectively, primarily through effects on the stonefly nymph Nemoura and chironomid and blackfly larvae. Benthos populations of some genera of invertebrates showed significant decreases in numbers after some of the insecticide treatments, but these did not correlate with the organisms drifting in increased numbers and may simply reflect limitations of the sampling method (Surber sampling) dictated by the short lead time for the study.

In general, the impacts seen with the experimental formulations were considered comparable to those documented following previous aminocarb and fenitrothion applications of conventional formulations. Details of these studies are reported in:

McLeod, B. B. 1982. Terrestrial impact stuides on experimental aqueous formulations of spruce budworm control agents containing TRITON^R X-100, New Brunswick, 1982. Forest Pest Management Institute File Report 37.

Holmes, S. B. 1982. Aquatic impact studies on experimental aqueous formulations of spruce budworm control agents containing TRITON^R X-100, New Brunswick, 1982. Forest Pest Management Institute File Report 38.

Laboratory studies

Static laboratory bioassays were conducted to determine the toxicity of aminocarb and fenitrothion field formulations containing TRITON^R X-100 to fingerling rainbow trout. LC_{50} values and lethal thresholds were calculated and a toxicity curve was constructed for each formulation tested. 96-hour LC_{50} and 95% confidence limits expressed in terms of nominal concentration (i.e., mg of field formulation/L of test water) were:

296.2 (238.0 - 368.3) mg/L for the MATACIL^{R} 180F - TRITON^{R} X-100 - water formulation, 17.6 (15.5 - 19.9) mg/L for the fenitrothion - TRITON X-100 - water formulation and 17.4 (14.9 - 20.2) mg/L for the fenitrothion - Cyclosol 63 - TRITON^{R} X-100 - water formulation. These are equivalent to 14.5 mg/L aminocarb and 2.4 and 2.5 mg/L fenitrothion respectively when expressed in terms of active ingredient content of the formulations.

Details of this work are reported in:

Holmes, S. B. 1982. Lethal toxicity of experimental aqueous formulations of spruce budworm control agents containing TRITON^{R} X-100 to rainbow trout. Forest Pest Management Institute File Report 42.

ICEWATER CREEK RESEARCH PROGRAM

In 1980, the Environmental Impact Section of FPMI, through the cooperation of the Sault Ste. Marie District Office of the Ontario Ministry of Natural Resources, set up an ongoing research program in the Icewater Creek watershed about 50 km north of Sault Ste. Marie, Ontario. The objective of this programme is: To examine in depth a number of aquatic and terrestrial habitats and micro-habitats and their resident animal populations to determine: (1) the nature and degree of inherent risk, (2) the level of actual exposure, and (3) actual response to forest pest management strategies involving aerial applications of pest control agents.

The program will have three distinct phases designed to generate information on three aspects of the effects of forest pest control activities on the environment: (1) potential risk (2) actual exposure and (3) actual response. In general, the actual impact on each part of the environment is primarily a factor of the susceptibility of that portion of the ecosystem to the particular pest control procedure and its level of exposure to the pest control agent used, i.e., Risk - Exposure = Response. To this extent, part of the objective of the first two portions of the program will be to help predict potential hazards of any suggested pest control action. The third portion of the program will test actual responses and elucidate the nature of and ecosystem responses to actual impacts. This will involve relating impacts at lower trophic levels or among specific groups of organisms to secondary impacts on higher trophic levels and changes within the ecosystem (e.g., altered food supply, changes in basic processes such as predation or pollination, etc.).

In 1982, terrestrial field studies in the Icewater Creek research area continued to concentrate on pollinators and pollination processes. Pollinator visitation patterns were studied on some 28 flowering plants, shrubs and trees, and taxonomic evaluation of pollinating insects collected

from various plants is underway. Honeybee utilization of pollen sources in the area was again studied in conjunction with a flowering plant survey, and ground insect fauna and activity on two distinct ecological sites were monitored over the entire season. Forest songbird studies evaluated the efficiency with which breeding populations could be censused with various census times in an effort to determine optimum plot shape and census time for various monitoring situations.

Aquatic studies in Icewater Creek in 1982 focused on seasonal changes in fish populations at a number of sites within the watershed, and collection of emerging adult aquatic insects for evaluation of both taxonomic and life history aspects of the invertebrate fauna. Benthos studies continued to evaluate two different sampling techniques used to study benthos populations throughout the watershed over the entire year.

Icewater Creek research studies contemplated for 1983 will focus on wild pollinator pollen and nectar source utilization and the potential pesticide exposure associated with the blossoms of various wild flowers, shrubs and trees. Aquatic studies will continue to focus on fish populations and their movements within the watershed, along with continued life history studies on aquatic invertebrates.

THE IMPACT OF TWO EXPERIMENTALLY-APPLIED AMINOCARB FORMULATIONS ON STREAM PERIPHYTON COMMUNITIES

by

G. B. Bacon
Research and Productivity Council

The analytical benefits, derived from species diversity in benthic diatom community structure, were used to assess the impact of experimentally-applied Aminocarb Flowable and Aminocarb in 585 Oil on the microphytic component of stream vegetation. In addition, samples of periphyton were analyzed chemically for the presence of aminocarb residues.

Glass plate collectors were deployed in stretches of Manzer Stream to permit colonization during the two weeks prior to the days of experimental applications (82-06-01; 82-06-15).

Samples collected from control and treatment stretches of the stream at t = -1h, 1h, 3h and 6h, and prepared with acid fuchsin stain indicated that 70-90% of colonized diatoms were alive during the experiment. Samples of drift periphyton collected at t - 1h and 7h indicated that 40-50% of these specimens were alive during the experiment.

No evidence appeared to suggest that application of the aminocarb was influencing ratios of living:dead diatoms in the stream.

Samples from colonized plates and from drift which were analyzed using the Coefficient of Community and Percentage Similarity of Community, also revealed no evidence of an impact, since shifts in species diversity and dominance amongst controls was as great or greater than that amongst treatment samples.

Analyses of periphyton samples collected immediately following spray application and at 7h post spray in effect indicated no accumulation of aminocarb had occurred. However, ppm levels of fenitrothion were discovered in some samples and are thought to have been present in others.

ADDENDUM TO THE NOVEMBER 1981 REPORT TO ENVIRONMENT NEW BRUNSWICK ENTITLED "FENITROTHION ACCUMULATION BY PLANTS AND INVERTEBRATES IN TWO EXPERIMENTALLY SPRAYED STREAMS IN NEW BRUNSWICK"

M. DeGraeve, Monenco Limited, 1982

In 1981 Montreal Engineering Company, Limited monitored fenitrothion and 3-methyl-4-nitrophenol in both plant and benthic invertebrate tissues in Manzer Brook and Otter Brook following an experimental application of fenitrothion to the streams. Trace amounts (0.025 ug/L) of fenitrothion were found in water samples from Manzer Brook up to 168 hours after the experimental application, and the concentrations in water samples from Otter Brook ranged from 0.07 ug/L 24 hours postspray to trace levels 96 and 169 hours postspray (Sosiak, 1981). Eidt (1982) also monitored fenitrothion levels in organic sediments following the same experimental spray application.

Both fenitrothion and 3-methyl-4-nitrophenol were found in plant and benthic invertebrate tissues and fenitrothion was detected in organic sediments. Fenitrothion was particularly persistent in tissues of the liverwort Solenostoma sp. Consequently, in late May/ early June of 1982 we collected liverwort and organic sediment samples to determine if fenitrothion and/or 3-methyl-4-nitrophenol were still present a full year after application of the insecticide.

Table 1 presents the results of the 1982 monitoring program. No fenitrothion or 3-methyl-4-nitrophenol was detected in organic sediments from Manzer or Otter Brooks. However, the liverworts Riccia sp. and Solenestoma sp. both contained detectable levels of fenitrothion about one year after the experimental applications, in some cases, more fenitrothion than was measured 7 days after spraying (Table 2). Although the sample size was small in both 1981 and 1982, the results indicate that Solenostoma sp. is a very good species for monitoring fenitrothion persistence in stream communities and that fenitrothion can persist in the tissues of this liverwort for at least one year. Because Solenostoma sp. is frequently abundant in New Brunswick streams, this species may be ideal to use as a tool for determining the level of long-term persistence of fenitrothion in areas repeatedly sprayed to control spruce budworm.

TABLE 1-1

Concentrations (µg/g dry weight) of Fenitrothion and 3-methyl-4-nitrophenol in liverwort and sediment samples from Manzer Brook[a] and Otter Brook[b]

Manzer Brook Substrate	Compound	Concentration	Otter Brook Substrate	Compound	Concentration
Sediment Sample 1	Fenitrothion	N/D	Sediment Sample 1	Fenitrothion	N/D
	3-methyl-4-nitrophenol	N/D		3-methyl-4-nitrophenol	N/D
Sediment Sample 2	Fenitrothion	N/D	Sediment Sample 2	Fenitrothion	N/D
	3-methyl-4-nitrophenol	N/D		3-methyl-4-nitrophenol	N/D
Riccia sp.	Fenitrothion	0.6	*Solenostoma* sp. Sample 1	Fenitrotthion	1.6
	3-methyl-4-nitrophenol	N/D		3-methyl-4-nitrophenol	N/D
Solenostoma sp.	Fenitrothion	3.6	*Solenostoma* sp. Sample 2	Fenitrothion	0.9
	3-methyl-4-nitrophenol	N/D		3-methyl-4-nitrophenol	N/D
			Solenostoma sp. Sample 3	Fenitrothion	1.7
				3-methyl-4-nitrophenol	N/D

[a] Sediment samples and *Riccia* sp. collected on 19 May 1982; *Solenostoma* sp. sample collected 1 June 1982

[b] Sediment samples collected on 24 May 1982; *Solenostoma* sp. samples collected 24-26 May 1982

TABLE 1-2

Comparison of 1981[a] and 1982 Fenitrothion Levels (µg/g)
in Plant Tissues in Manzer and Otter Brook

Manzer Brook			Otter Brook		
Riccia sp.	1981	0.23	*Solenostoma* sp.	1981	2.91
	1982	0.60		1982	1.60
					0.90
					1.70
Solenostoma sp.	1981	0.95			
	1982	3.60			

[a] Levels shown for 1981 are those detected 96 and 168 hours postspray for *Riccia* sp. and *Solenostoma* sp. respectively.

AMINOCARB AND FENITROTHION IN AQUATIC PLANTS AND BENTHIC MACROINVERTEBRATES

M. DeGraeve, Monenco Limited, 1982

The purpose of the study was to collect and analyse aquatic plants and benthic macroinvertebrates for aminocarb following its application by manual and aerial spraying to sections of three streams in New Brunswick (Manzer Brook, Yoho Stream and Bear Brook).

Aminocarb was detected at trace levels in only a limited number (8 percent) of the samples of aquatic plants and benthic macroinvertebrates collected within a 4 day period following spraying. Aminocarb phenol, a degradation product of aminocarb, was not detected in any of the more than 50 samples that were collected.

The gas phase chromatographic analyses, carried out by the University of Moncton, showed the presence of fenitrothion during analyses for aminocarb. The scope of the project was thus extended to include analyses for fenitrothion. Fenitrothion was detected in 99 percent of the samples of aquatic plants and benthic macroinvertebrates. This was unexpected as the samples had been collected from areas that had not been directly sprayed with fenitrothion more recently than 1981. These sample sites were, however, only 10 to 30 km from areas that were sprayed with fenitrothion during the sample collection period as part of the Province's 1982 budworm control program. Hence, drift of fenitrothion spray into the sample sites cannot be excluded as a source of fenitrothion detected in the samples.

The study recommended that at least qualitative analyses by carried out to confirm that fenitrothion was the chemical substance detected in the samples of aquatic plants and benthic macroinvertebrates.

PRELIMINARY DATA REPORT ON STUDIES CONDUCTED BY THE ENVIRONMENTAL PROTECTION SERVICE IN RELATION TO FORESTRY PESTICIDE PROGRAMS IN THE MARITIME REGION

Report to the 1982 Canadian Forest Pest Control Forum

W. R. Ernst, Environmental Protection Service

During the past year, the Environmental Protection Service undertook a number of field and laboratory studies related to forest spray activities.

EFFECTIVENESS OF STREAM BUFFERS

The first of these was a study to determine if the watercourse buffer zones which are observed in the Province of New Brunswick are effective in reducing the deposit of spray formulation in the protected watercourse. The design consisted of the selection of two small streams within an operational block and running two transects of deposit samplers extending to 400 metres on either side of each stream, as well as the assembly of pumping systems to monitor the surface concentrations of active ingredient. One stream was buffered with a 400 metre no spray zone while on the other spray booms were shut off and reactivated at the margin. Both streams were in a block which received two applications of a fenitrothion (11%), Cyclosol 63 (35%), and 585 oil (54%) formulation at 210 g ai/ha. Deposit and residue concentrations were monitored after each spray event.

The results (Figure 1) indicate that while the deposit was much more variable adjacent to and on the unbuffered stream, there was no appreciable difference in the amount of pesticide deposited on the buffered and unbuffered streams. The greatest individual stream residues were also observed in the unbuffered stream (Figure 2); however, there was no substantial difference in the two streams when the two spray events were averaged. While these results were obtained from a limited number of samples, they do question the utility of buffer zones on streams and indicate that a much closer examination is probably warranted.

BRAIN CHOLINESTERASE RESPONSE OF BROOK TROUT TO EXPERIMENTAL FIELD APPLICATIONS OF FENITROTHION/TRITON AND AMINOCARB/TRITON FORMULATIONS

During the past year, EPS also conducted field studies in order to monitor the effect on fish of a number of experimental formulations as part of the CFS/FPMI Action Plan to test alternative emulsifying agents to Atlox 3409. The work was done in the Nepisiguit River drainage area, southwest of Bathurst, New Brunswick. Three experimental blocks received two sequential applications of the experimental formulations delivered by TBM aircraft and one manual application directly to the stream. The formulations were:

1. Fenitrothion (10.9%), Triton X100 (10.7%), and water (78.4%);
2. Fenitrothion (10.9%), Cyclosol 63 (24%), Triton X 100 (3%) and water (62%);
3. Matacil 180 F (26.7%), Triton X 100 (3%), and water (70.3%).

The dosage rates for aerial applications were 210 g ai/ha fenitrothion

and 70 g ai/ha aminocarb. Streams received a direct treatment. The calculated stream concentrations for the manual treatment were 125 ug/L fenitrothion and 250 ug/L aminocarb.

Fish in streams situated in the three experimental blocks and a control area were sampled before and after treatments. Their brain cholinesterase activities and gut contents were determined.

There was a considerable amount of individual variability in cholinesterase activities within treatments. (Table 1). Fish in treated streams displayed a decrease in cholinesterase activity within 72 hours of aerial applications when compared with fish from the control stream. The decrease in cholinesterase activity was most pronounced, and significantly different from control values, in the fish from the block treated with the aminocarb formulation (Figure 3). Fish from the brook treated with the fenitrothion, Triton, Cyclosol formulation demonstrated the next greatest depression in ChE activity (Figure 4). Fish from the stream which received the fenitrothion and Triton formulation displayed the least pronounced depression in cholinesterase activity and the difference was not significant compared with controls (Figure 5). Maximum mean cholinesterase depression in treated streams, compared with control mean values, were: 19% for fish from the fenitrothion, Triton block; 26% for fish from the fenitrothion, Triton and Cyclosol block; and 39% in fish from the aminocarb and Triton block.

These results are somewhat consistent with the pesticide residue analyses performed at the Forest Pest Management Institute, which indicated that the highest active ingredient concentrations after aerial applications were observed in the stream within the aminocarb block (peak concentrations after first and second spray events were 2.26 and 0.53 ppb respectively). The analytical results also indicated there were probably no real differences in the peak fenitrothion concentrations in the two streams treated with the different formulations (a maximum concentration of 1.84 ppb occurred in the fenitrothion, Triton stream after the second application).

After the ground applications, up to 6 hours after spray, the cholinesterase activity in fish from the aminocarb and the fenitrothion and Triton treated blocks dropped. In contrast, fish from the fenitrothion, Triton, and Cyclosol treated block demonstrated an increase in cholinesterase activity. No changes were significant, however.

The results of qualitating and quantifying the gut contents of fish taken from the treated areas after various applications have not been entirely completed at present. It appears, however, that the greatest changes in the feeding activities of fish took place after the first aerial application in the brook treated with the fenitrothion and Triton only formulation (Figure 6). Within one day of the spray event, the stomachs of fish taken from this stream contained approximately ten times as many food items as those of fish taken one day prior to the spray event. Most of the additional numbers consisted of knocked down Lepidoptera, primarily budworm. The Lepidoptera species formed approximately 92% of the total diet at this time.

The changes in feeding activity of fish from the fenitrothion, Triton, Cyclosol block were similar in pattern although not as pronounced and somewhat delayed.

Fish from the aminocarb, Triton treated block demonstrated a significant shift towards the ingestion of Lepidoptera after the spray events; however, this was much less marked than in the fenitrothion blocks and total numbers decreased. The cause of this remains to be determined; however, it is possible that the significant cholinesterase depression in these fish may have resulted in a decreased ability to catch food organisms.

DRIFT POTENTIAL OF GROUND AND AERIALLY APPLIED FORESTRY HERBICIDES

A small study was also undertaken to compare the drift potential of ground and aerially applied forestry herbicides. Three sites were monitored for deposit and air concentrations of herbicide with distance from the target site after application of a water formulation of a 50:50 mixture of the iso-octyl ester of 2,4-D and the propylene butyl ester of 2,4,5-T. The two helicopter treated sites received 3360 grams of total active ingredient per hectare, in a formulation of one part product to five parts water. The single ground application site received 5380 grams of total active ingredient per hectare in a formulation of one part product to five parts water. The helicopter, which was equipped with a boom and TEE Jet Nozzles (boom pressure 2800 gm/m^2), flew 15 metres above the ground at a speed of approximately 100 km/hr. The ground delivery was with hand-held spray wands (wand pressure 10.5 kg/cm^2) mounted on a Tree Farmer Forwarder.

Samples collected one hour after spray events indicated that deposit decreased rapidly and relatively linearly with distance from the spray block. A regression model provided a reasonably good fit of the data. Of interest is the fact that there was no substantial difference in the off-target drift between the two types of application. Since meteorological conditions were very similar during all spray events, and since the aircraft delivery had a considerably greater fall distance, the lack of a difference in drift potential is probably due to the smaller droplet spectrum produced by the higher pressures of the ground equipment.

Detection limits for air samples were not low enough to provide useful results.

TOXICITIES OF FENITROTHION, AMINOCARB AND 2,4-D TO RAINBOW TROUT

Finally, a series of laboratory toxicity studies were conducted in order to assess the interactive effect of ambient water pH on pesticide toxicity to rainbow trout. The chemicals which have been tested to date are fenitrothion, aminocarb and 2,4-D. All tests were acute (96hr) lethal bioassays and the pHs tested ranged from 4.5 to 8.5

Calculated LC50s for fenitrothion (Table 2), based on nominal concentrations, were not observed to change significantly throughout the range of pHs tested. The toxicity of aminocarb, on the other hand, increased dramatically with increasing pH, the LC50 at pH 8.5 being approximately 15 times the LC50 at pH 4.5. The 2,4-D tests indicated that the toxicity increased dramatically as pH decreased, the reverse of the aminocarb change, with the magnitude of change approximating that observed for the aminocarb.

The reasons for the dramatic changes in pesticide toxicity with pH change remain to be determined. It is probable that they relate to chemical changes or to physiological changes of the test species. A better estimate of such changes should be available upon completion of the analyses for test concentrations of the pesticides during the duration of the experiments. The tests appeared to be highly reproducible, as evidenced by the fact that a triplicate test of the aminocarb toxicity at pH 7.0 yielded LC50s which varied by no more than 6%.

Of additional interest is the fact that the same test solution of aminocarb lost little of its toxicity, as measured by five separate LC50 determinations, over a period of approximately one month. During this time, LC50s were determined at pH 8.5, pH 7.0, pH 4.5 and again at pH 7.0. Analysis of test solutions for aminocarb content during this time remains to be completed and should help to explain some of these findings.

TABLE 1 BRAIN CHOLINESTERASE ACTIVITIES IN BROOK TROUT TAKEN FROM STREAMS IN EXPERIMENTAL BLOCKS AT VARIOUS TIMES AFTER TREATMENT

TREATMENT	DATE	TIMING	NO. ANIMALS SAMPLED	BRAIN ChE ACTIVITY mU/mg Brain MEAN ± S.D.	RANGE
Fenitrothion, Triton X 100 Water	June 20	72 hrs post 1st aerial	4	8.1 ± 0.3	7.8 - 8.4
	June 25	12 hrs post 2nd aerial	6	7.4 ± 1.0	6.6 - 8.7
	June 27	72 hrs post 2nd aerial	6	6.6 ± 1.1	5.2 - 8.2
	July 7	Pre-spray hand appl.	6	9.6 ± 2.0	6.6 -11.7
	July 7	2 hrs post hand appl.	5	7.4 ± 2.3	5.4 -11.2
Fenitrothion, Triton X 100 Cyclosol 63 Water	June 23	12 hrs post 1st aerial	6	7.2 ± 0.5	6.8 - 7.7
	June 26	72 hrs post 1st aerial	6	5.9 ± 1.7	4.3 - 7.9
	June 29	12 hrs post 2nd aerial	6	5.9 ± 2.1	3.7 - 7.9
	July 7	pre-spray hand appl.	6	8.1 ± 1.0	7.4 - 9.3
	July 7	2-6 hrs post hand appl.	10	9.6 ± 1.4	7.8 -10.9
Matacil 1.8 F Triton X 100 Water	June 20	72 hrs post 1st aerial	6	5.0 ± 0.9	4.5 - 6.1
	June 25	6 hrs post 2nd aerial	7	4.8 ± 1.9	2.3 - 7.3
	June 28	72 hrs post 2nd aerial	4	4.9 ± 1.4	4.8 - 5.5
	July 7	pre hand appl.	5	6.6 ± 0.7	5.9 - 7.3
	July 7	2-6 hrs post hand appl.	10	5.7 ± 1.4	3.9 - 8.8
Control	June 20		6	7.9	7.7 - 8.1
	June 23		6	8.0 ± 1.1	6.8 - 8.5
	June 27		6	8.2 ± 2.5	6.0 -11.0
		TOTAL	18	8.1 ± 1.5	6.0 -11.0

TABLE 2 TOXICITY OF PESTICIDES AT DIFFERENT pHs

Values are 96-hour LC50s to Rainbow Trout

pH of Test Solution	Pesticide		
	Fenitrothion	2,4-D	Aminocarb
4.5	1.9 (CL:* 1.5-2.3)	67.3 (CL: 48.3-74.3)	106.7 (CL: 92-121.4)
5.5	2.9 (R:** 1.8-5.6)	420 (R:320-560)	61.2 (CL: 35.5-86.9)
7.0	3.3 (R: 1.8-5.6)	1000 (Limits not calculable)	56 (R:32-100)
8.5	3.0 (R: 1.8-5.6)	>1000	7.5 (R: 5.6-10)

* CL = 95% confidence limits

** R = Range from 0% mortality to 100% mortality

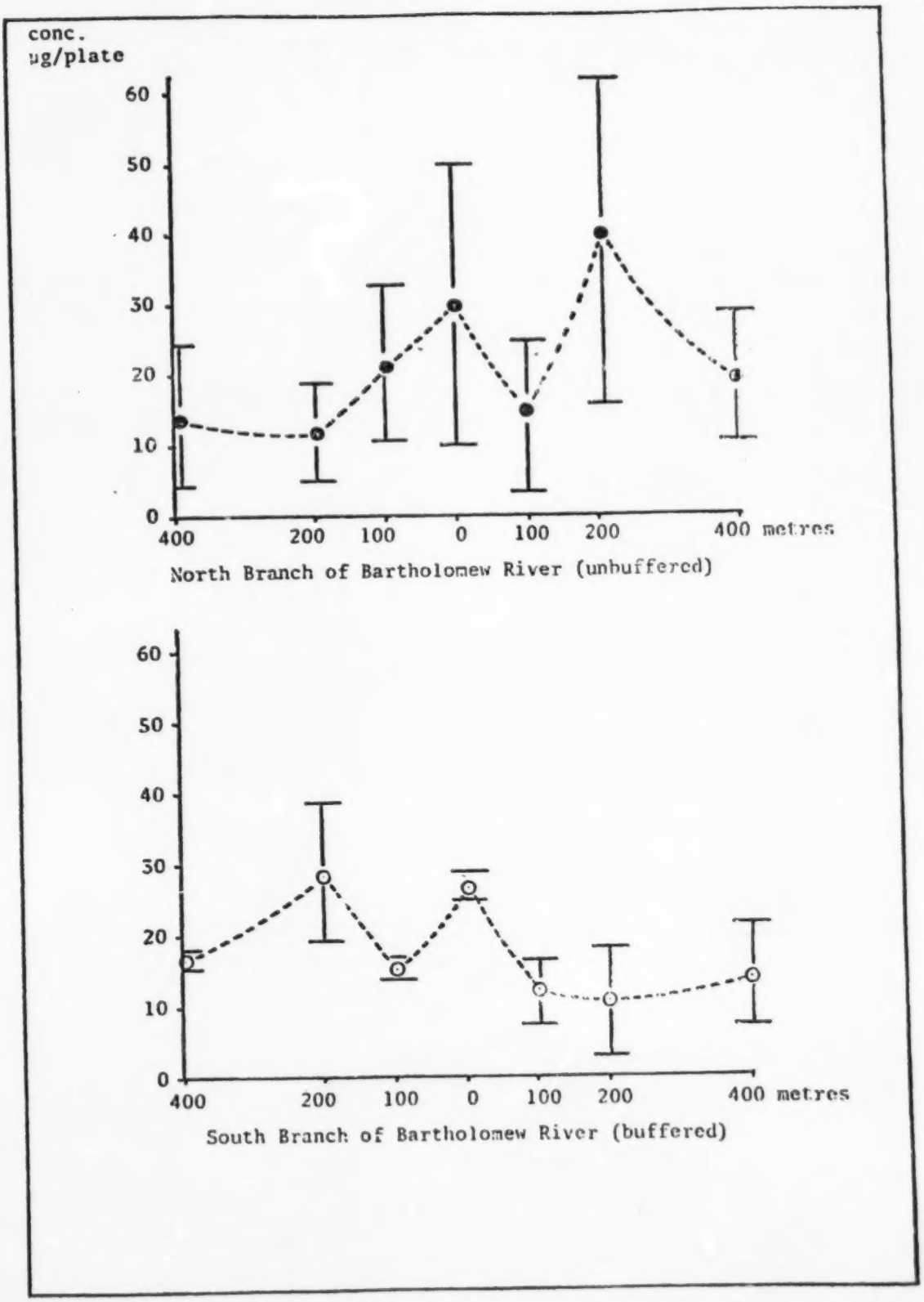


FIGURE 1 MEAN RESIDUE DEPOSITS NORTH AND SOUTH BRANCH BARTHOLOMEW RIVERS

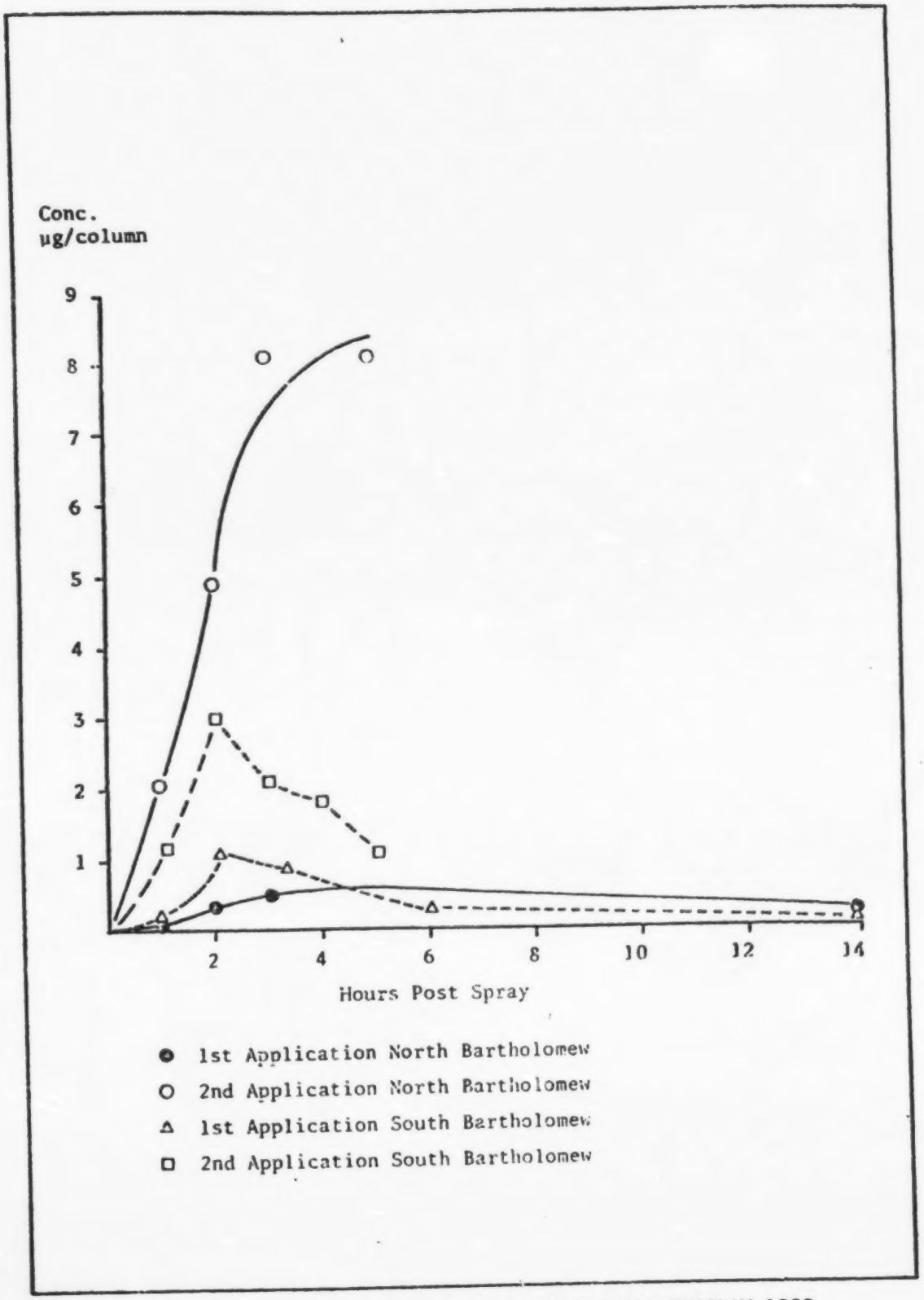


FIGURE 2 FENITROTHION RESIDUES N.B. BUDWORM SPRAY PROGRAM 1982

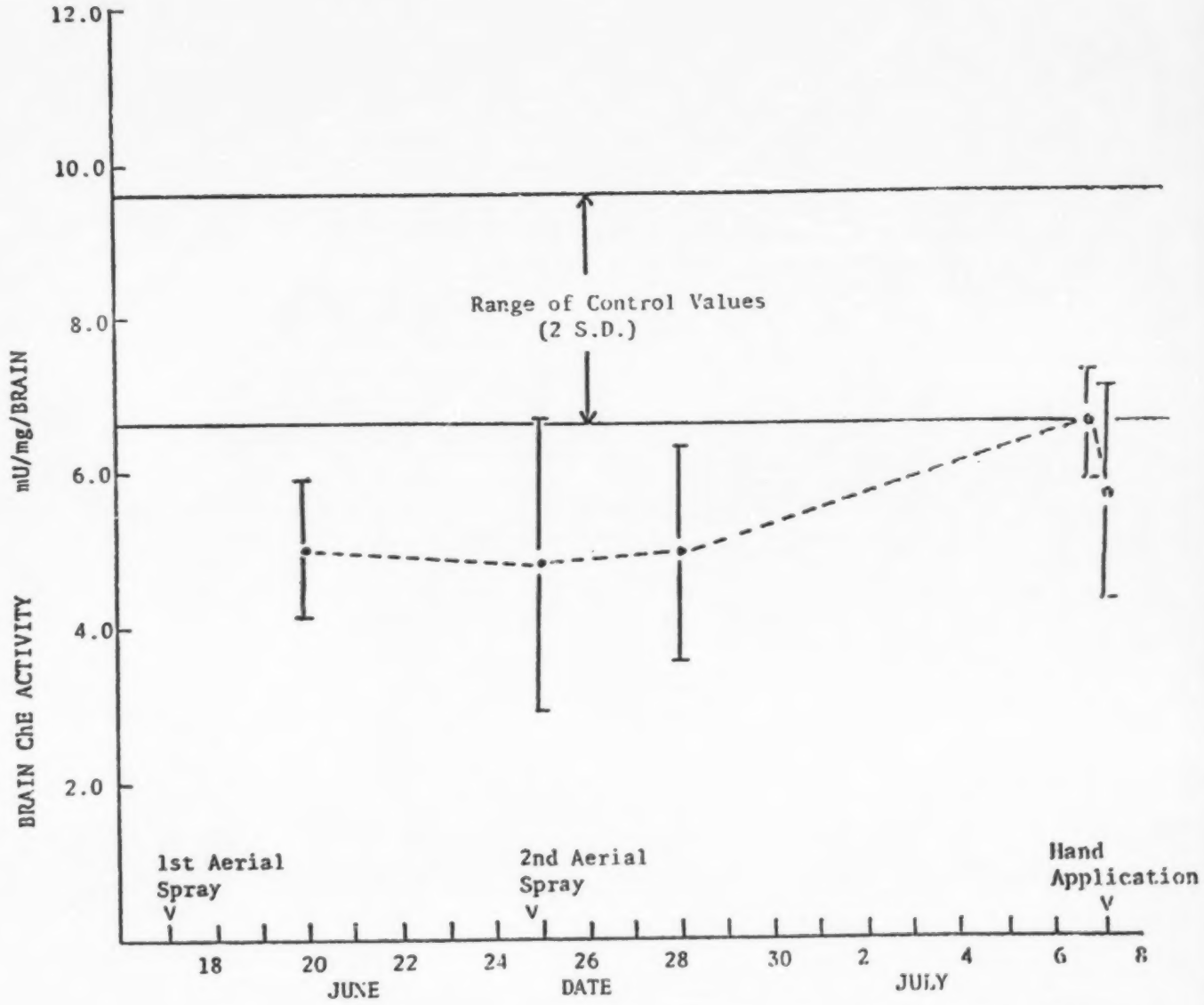


FIGURE 3 BRAIN CHOLINESTERASE ACTIVITY IN BROOK TROUT (Salvelinus fontinalis) FROM A BROOK TREATED WITH A FORMULATION OF MATACIL 1.8 F, TRITON X 100, WATER

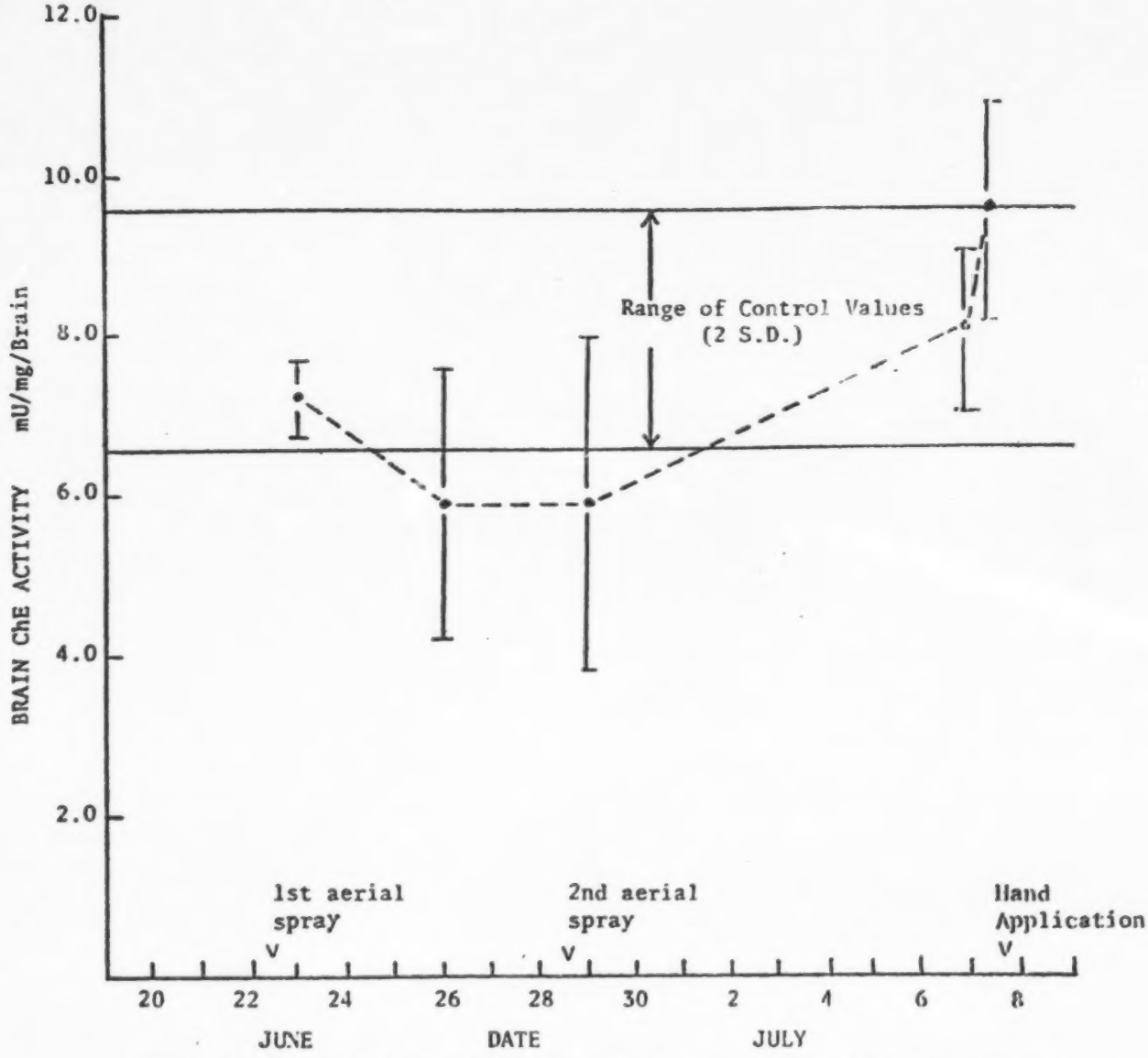


FIGURE 4 BRAIN CHOLINESTERASE ACTIVITY IN BROOK TROUT (Salvelinus fontinalis) FROM A BROOK TREATED WITH A FORMULATION OF FENITROTHION, TRITON X 100, CYCLOSOL 63, WATER

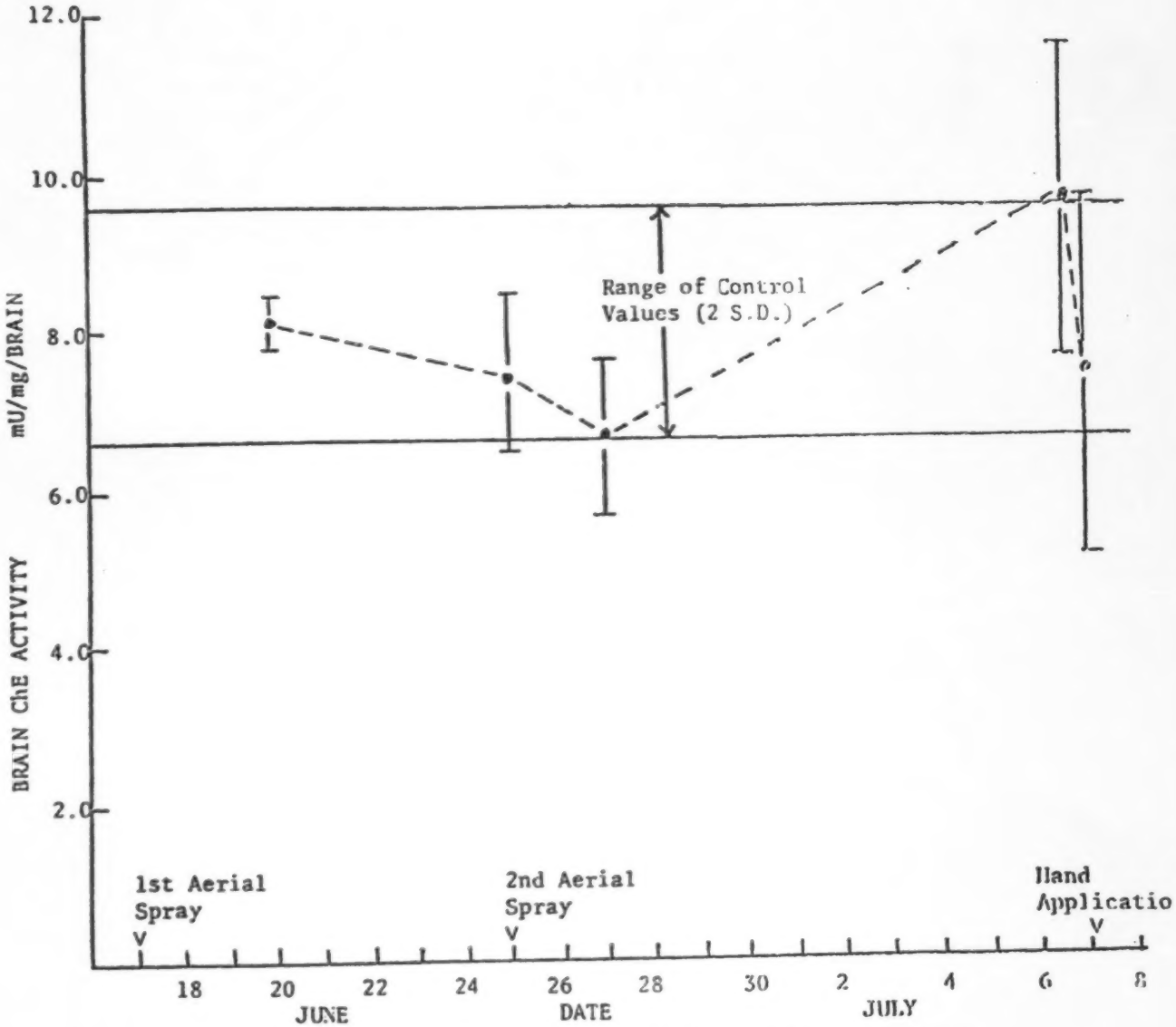


FIGURE 5 BRAIN CHOLINESTERASE ACTIVITY IN BROOK TROUT (Salvelinus fontinalis) FROM A BROOK TREATED WITH A FORMULATION OF FENITROTHION, TRITON X 100, AND WATER

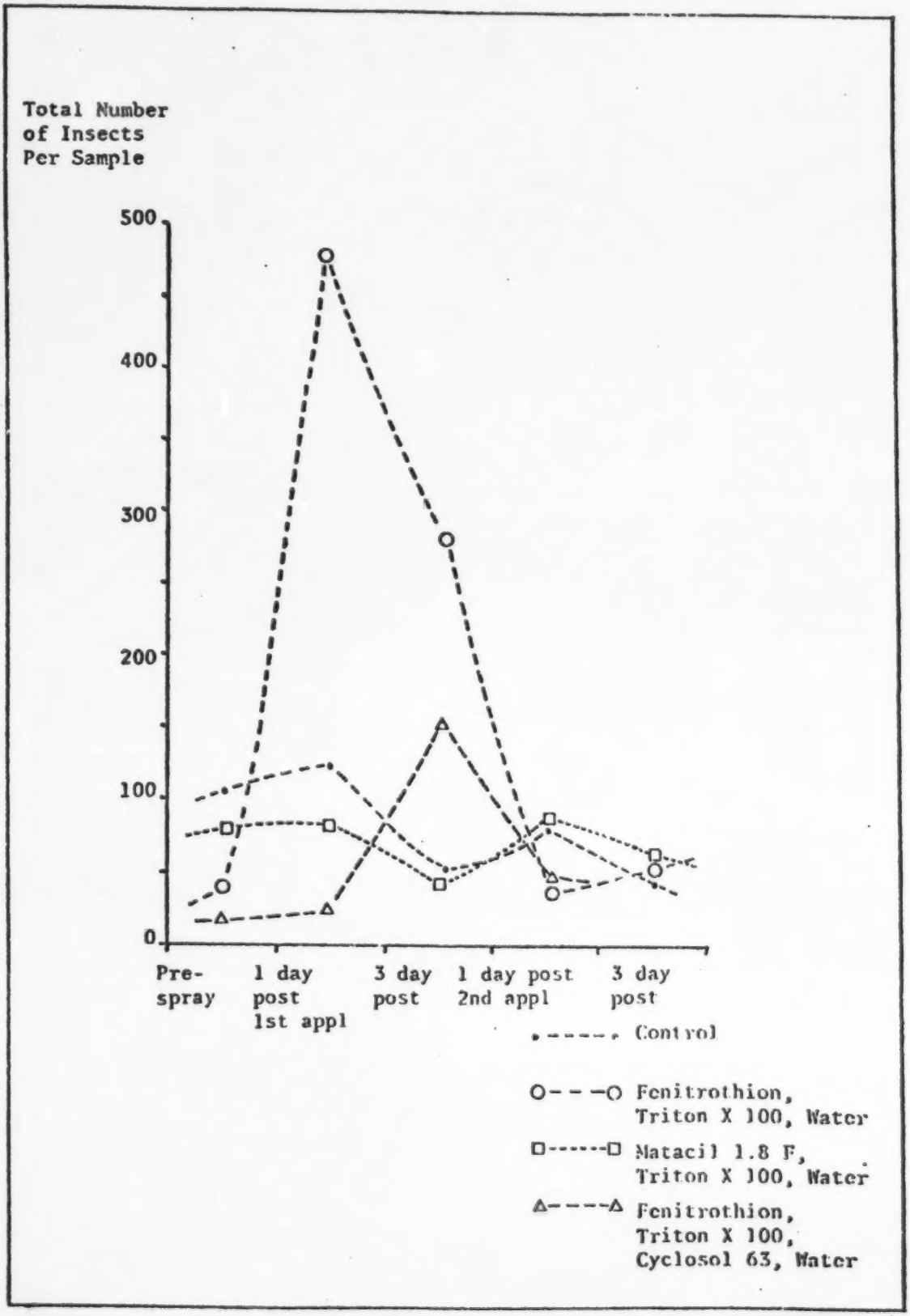


FIGURE 6 TOTAL NUMBER OF INSECTS IN STOMACHS OF BROOK TROUT (Salvelinus fontinalis) TAKEN FROM STREAMS TREATED WITH EXPERIMENTAL SPRAY FORMULATIONS

A CHEMICAL RESIDUE SURVEY IN RELATION TO THE 1982 SPRUCE BUDWORM SPRAY PROGRAM IN NEW BRUNSWICK (CANADA)

Key words: fenitrothion, spruce budworm, spray program, residue survey

V. N. Mallet and A. Cassista
Chemistry Department, Université de Moncton
Moncton, N. B. (Canada) E1A 3E9

ABSTRACT

The data from the analysis of 96 samples of water, air, coniferous foliage, sediment and soil litter for fenitrothion (0,0-dimethyl 0-3 methyl-4-nitrophenylphosphorothioate) and nitrocresol (3-methyl-4-nitrophenol) in relation to the 1982 Spruce Budworm Spray Program in N. B. are presented in this report.

Pre-spray water samples contained low levels (0.001-0.01 ppb) of fenitrothion which increased following spraying to a maximum of 0.79 ppb, then decreased to sub ppb levels several weeks later. Fenitrothion was detected on several occasions in air samples but the amounts were negligible (max. 0.04 ng/L).

In other substrates, namely, soil litter, coniferous foliage and sediment, there was strong evidence of pre-spray contamination which persisted in most cases (but not at all the sites), throughout the sampling period (which ended August 16). The maximum was detected in coniferous foliage (0.53 ppm) while sediments seemed to be the least contaminated.

AMINOCARB PARTITIONING IN A STREAM

Report to the Forest Pest Control Forum

D. C. Eidt, Maritimes Forest Research Centre

V. N. Mallet, and Université de Moncton

Our objective was to determine where aminocarb goes in a stream environment. The reason for doing this was the same one as that for our work with fenitrothion in 1981. It has been suggested that, with partitioning in the aqueous environment, toxic concentrations of pesticides and their derivatives could occur in some niches and thereby threaten the organisms that live there. The work was done in cooperation with Dr. G. B. Bacon of the New Brunswick Research and Productivity Council and Mr. M. DeGraeve of Monenco, Ltd., who studied residues in algae, bryophytes, higher plants and aquatic insects. Their results are not reported here.

A stretch of Manzer Brook, New Brunswick, was treated using a backpack mist blower with aminocarb in aqueous formation (99.6 mL Matacil^{R} 180F - 3.7 mL Atlox 3409F applied in 1h 7 min when streamflow was 92.2 L/sec). Concentrations in water up to 23.5 ug aminocarb/L - 2.7 ug aminocarb phenol/L were found. Aminocarb phenol formed almost immediately. Complete mixing of insecticide from top to bottom and into the stream bottom interstices occurred within an hour, 68 m downstream of the treated stretch.

In a like manner a stretch of Manzer Brook upstream was treated by injection two weeks later with aminocarb in oil formulation (22 mL Matacil^{R} 180F - 66 ml 585 oil applied in 1 h 7 min when streamflow was 26.7 L/sec.). The maximum concentration found was 12.9 ug/L of aminocarb - 0.5 ug aminocarb phenol. Again, aminocarb phenol was found almost immediately and a complete mixing of aminocarb occurred within one hour, 93 m downstream of the injection site.

Water was filtered and both filtrates and residues were analysed. Only at the most upstream site in the stretch treated with aqueous formulation was aminocarb found in the residue. This probably occurred because the aminocarb particles had not yet dissolved, and there is thus no reason to believe that aminocarb was sorbed on suspended particles. Aminocarb phenol was not found in the residues but was found along with aminocarb in every filtrate analysed.

In sediments collected the day of treatment, and 1, 7 and 15 days after, from the stretch treated with aqueous formulation, traces of aminocarb were found in four and measurable amounts in only two of 24

samples taken. Trace amounts of aminocarb phenol were found in two and a measurable amount in only one of 24 samples.

Water samples and sediment samples were routinely analysed for fenitrothion. In 42 water samples analysed, all but one contained some fenitrothion ranging from 0.01 to 0.6 ug/L or not measurable due to interference but nonetheless present. In residues from filtered samples, traces to 0.56 ug of fenitrothion/g of residue were found and 0.04 to 2.3 ug/L were found in the filtrate. In sediment, amounts ranging from traces to 0.12 ug/g dry weight were found in most samples. Operational spraying had begun 6 km and farther to the west and north before these samples were taken.

EFFECTS OF FENITROTHION ON FOREST LITTER DECOMPOSITION

Report to the Forest Pest Control Forum

D. C. Eidt and C. A. A. Weaver

Maritimes Forest Research Centre

The objective was to determine if forest litter decomposition is affected by large doses of fenitrothion and the usual adjuvants used in operational spraying. This was regarded as a measure of the activity of the effects of the chemicals on organisms involved in decomposition, in particular, the soil arthropods. Direct observations of arthropods were contemplated but the idea was abandoned because of the poor state of our knowledge of arthropods inhabiting forest litter.

Plots 10m x 10 m were established in a uniform spruce forest in the UNB woodlot. There were seven treatments each replicated 4 times as follows:

Formulation	Rate (A.I.)
2.1 ml emulsifiable concentrate in water (includes 0.22 ml Atlox 3409 F)	210 g/ha
21 ml emulsifiable concentrate in water (includes 2.2 ml Atlox 3409F)	2100 g/ha
2.2 ml Atlox in water	2100 g/ha equivalent
approx. 16.6 ml fenitrothion + 53 ml Cyclosol + 81 ml 585 oil	approx. 2140 g/ha
approx. 3.0 ml fenitrothion + 10 ml Cyclosol + 15 ml 585 oil	approx. 400 g/ha
approx. 53 ml cyclosol + 81 ml 585 oil	approx. 2100 g/ha equivalent
control, no treatment	0

Saran litter bags were filled with weighed amounts of preleached spruce needles and placed on the plots before treatment. Ten bags were collected 30, 60 and 120 days after treatment. Needles were dried, weighed and compared with pretreatment weights. No differences have been found between treatments and controls to date. A fourth collection is scheduled for 365 days after treatment.

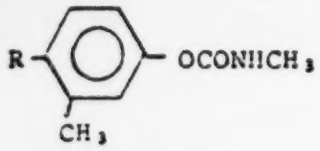
STUDY OF THE INTERACTION OF MATACIL AND L-ASCORBIC ACID

by

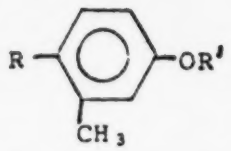
Marc Cool and K. Jankowski
Département de chimie
Université de Moncton
Moncton, N.-B.
E1A 3E9, Canada

Abstract

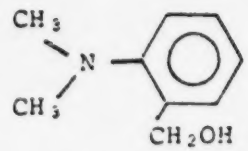
The ferro-ascorbic oxidation system is a model simulating the biological oxidation of aromatic compounds. Matacil (1), an aromatic carbamate insecticide whose biodegradation is not very well known, has been oxidized by this system. We have studied the interaction of 1 and L-ascorbic acid (2) using GC, GC-MS and radio-GC on the ^{14}C labelled lactone carbonyl of compound 2.



1 R = $N(CH_3)_2$
4 R = $NHCH_3$
5 R = CH_3-N-CH_2OH
6 R = NH_2
10 R = N-CHO



3 R = $N(CH_3)_2$ R' = H
7 R = NH CHO R' = H
8 R = CH_3NCH_2OH R' = H
9 R = H, R' = $OCONH_2$
15 R = $NHCH_3$, R' = OCH_3
16 R = CH_3-N-CH_2OH, R' = H
14 R = $NHCH_3$, R' = $CON(CH_3)_2$



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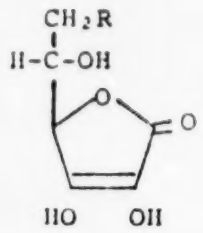
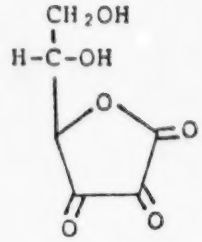


2 R = OH
13 R = H



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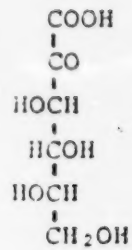

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Matacil (1) and L-ascorbic acid (2) degradation products

Figure 2

1982 PESTICIDE STUDIES

Monitoring of Off-Target Fallout During Spruce Budworm Spray Program

H. S. Bailey and T. L. Pollock

The 1982 monitoring of off-target fallout retained the aims of the 1981 study: (1) to determine the extent of the pesticide drift and (2) to determine the concentration of pesticides in sequential fractioned rain events.

In 1982, the sequential samplers capable of collecting approximately 3000 mL during a 10 mm rainfall event were placed at two sites in Fundy National Park - Wolfe Lake (as in 1981) and near the Administration Building. Duplicate bulk collectors were also employed at each site. The collectors were installed approximately a week before the spray program and remained in place for a week after the spray operation.

The bulk and sequential samplers utilized XAD-4 resin columns as pesticide collectors. The columns were retrieved for fenitrothion analysis after every rain event of 10 mm or more.

A total of 28 samples from the Administration Building site and 25 samples from Wolfe Lake were analyzed, resulting in a total of 6 positive values for fenitrothion ranging from 0.04 to 0.37 ug/L. All positive values were recorded the same day.

The absence of rain events during early June and the presence of only two spray blocks in the vicinity of the Park were probably contributing factors to the small number of positive values.

Fig. 1 - Bulk and Sequential Precipitation Collectors at Wolfe Lake Ranger Station, Fundy National Park

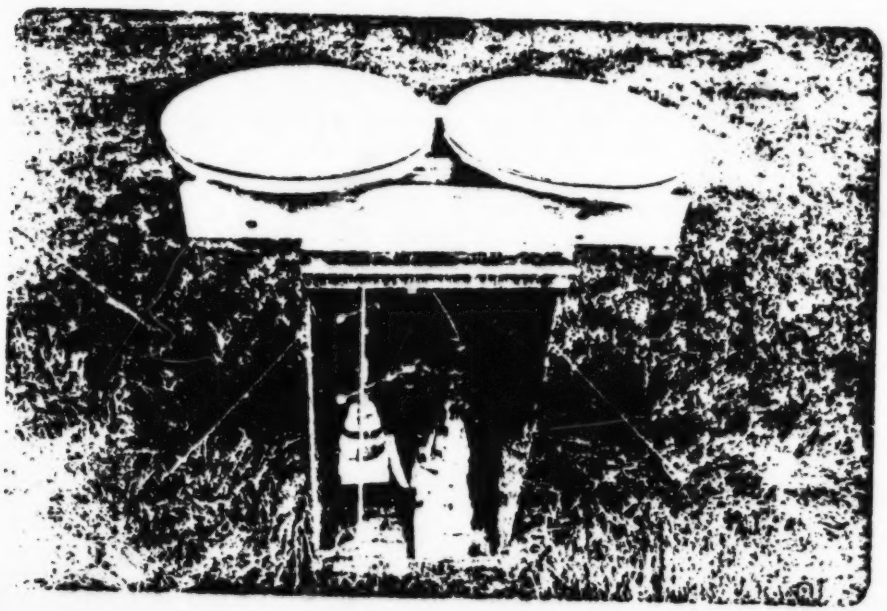

Fig. 2 - Sequential Precipitation Collector, Wolfe Lake, Fundy National Park

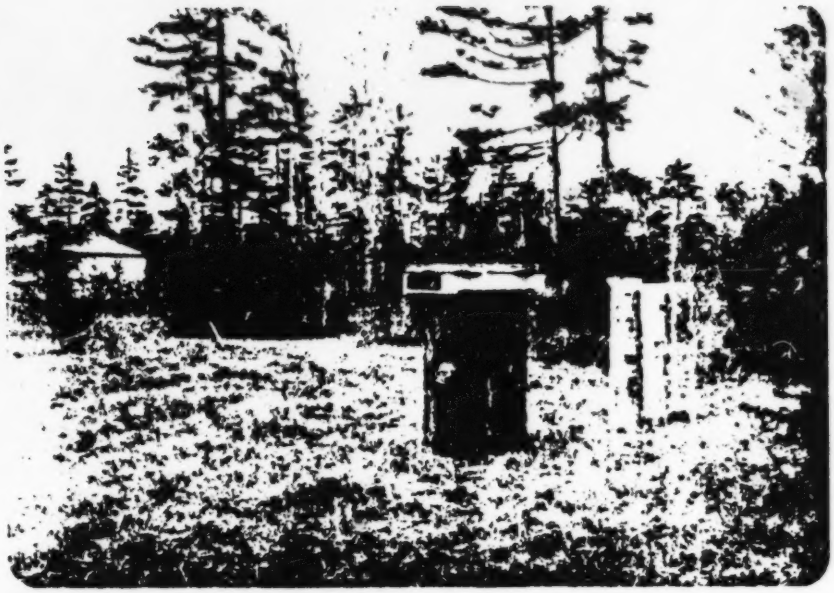

Fig. 3 - Bulk and Sequential Precipitation Collector Near Information Center, Kouchibouguac National Park

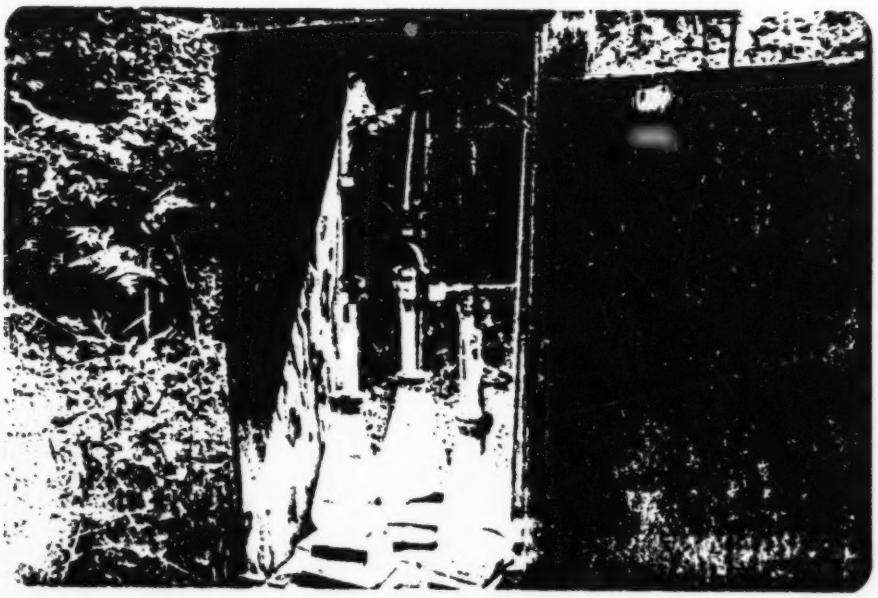

Fig. 4 - Sequential Precipitation Collector (as shown after rain event with two Erlenmeyer flasks filled to 1 - liter mark) Information Centre, Kouchibouguac National Park